

# **Lead-Contaminated Soils**

**Prepared for  
MTCA Science Advisory Board  
June 22, 2004**

## **Outline**

- Overview.
  - Working Definition for Lead-Contaminated Soils
  - How Might Ecology Respond to the Board's Recommendations?
- Additional Information
  - Exposure Reduction Measures
  - Exposure to Lead-Contaminated Soils – Incremental Impacts
- Review and Discuss SAB Responses to Ecology Questions
  - Upper End of the Moderate Range
  - Lower End of the Moderate Range
  - Soil Concentrations Below 250 mg/kg
  - Protection of Adults and Older Children
  - Protection of Ground Water
  - Future Information Collection and Evaluation
- Next Steps

## Overview

- The Areawide Soil Contamination Task Force recommended that Ecology use a tiered approach when responding to lead-contaminated soil problems.
- Ecology used the IEUBK model to establish a tiered approach for responding to lead-contaminated soils:
  - High Levels – soils with potential to cause PbB > 15 ug/dL
  - Moderate Levels – soils with potential to cause PbB between 10 and 15 ug/dL
  - Low Levels – soils unlikely to cause PbB > 10 ug/dL
- Ecology requested that the Science Advisory Board review the scientific bases for Ecology's working definition for moderate levels of lead-contaminated soils.

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## Task Force Recommendation Tiered Response

15 <b>High</b>	<ul style="list-style-type: none"><li>• Traditional Cleanup Processes and Measures (e.g. removal &amp; containment)</li><li>• Institutional Controls &amp; Periodic Review</li></ul>
<b>Moderate</b>	<ul style="list-style-type: none"><li>*1 • Broad-Based Education and Awareness</li><li>• Encourage and Support Early Implementation of Simple Containment Measures (Focus on Child Play Areas)</li><li>• Integrate More Permanent Containment Measures with New Construction/Renovations</li></ul>
10 <b>Low</b>	<ul style="list-style-type: none"><li>*2 • Periodic Program Review</li></ul> <hr/> <ul style="list-style-type: none"><li>• No Further Actions</li></ul> <p>*1 Add *2 Add</p>

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## **Moderate Levels of Lead Ecology Working Definition**

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	<b>Lower End of Range</b>	<b>Upper End of Range</b>
Residential Areas	<b>250 mg/kg</b>	<b>500 mg/kg</b>
Schools & Child Care Facilities	<b>250 mg/kg</b>	<b>700 mg/kg</b>
Commercial Facilities & Parks	<b>250 mg/kg</b>	<b>1000 mg/kg</b>

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## **How Might Ecology Use the Board's Recommendations?**

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- Revise the Working Definition
- Provide Additional Guidance Materials
- Consider Board Recommendations When Revising the Rule
- Conduct Additional Studies to Address Data Gaps and Uncertainties

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## **Additional Information Prepared To Support SAB Review**

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- Exposure Reduction Measures (Enclosure A)
  - Three Primary Soil Exposure Pathways
  - Three Categories of Intervention Measures
- Exposure to Lead-Contaminated Soils –  
Incremental Impacts on Blood Lead  
Concentrations

## **Exposure Reduction Measures**

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- Estimated Lead Uptake for Soil-Related Pathways (Soil Concentration = 500 mg/kg)
  - Soil/Dust Ingestion
  - Garden Vegetables
  - Inhalation of Re-suspended Dust
- Estimated Potential Reduction in Lead Uptake Associated with Different Intervention Measures
  - Education Intervention Measures
  - Interim Measures
  - Cleanup Measures

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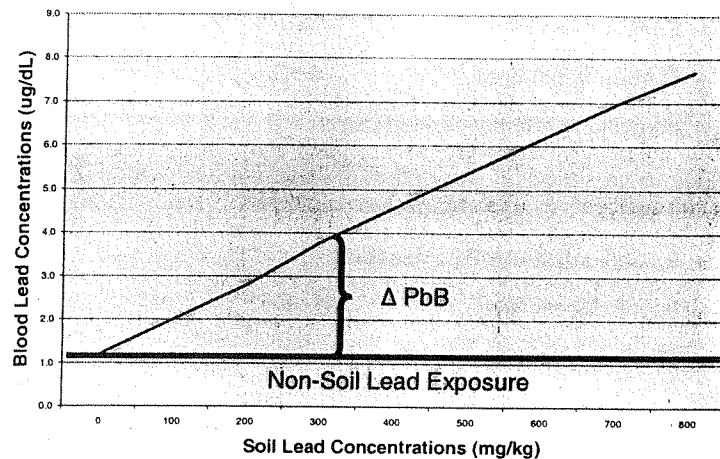
## **Exposure Reduction Measures**

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- Estimated Lead Uptake for Soil-Related Pathways (Soil Concentration = 500 mg/kg)
  - Soil/Dust Ingestion (@ 50 - 60%)
  - Garden Vegetables (@ 30 - 40 %)
  - Non-soil Lead Exposure (@ 10%)
  - Inhalation of Re-suspended Dust (< 1 %)
- Estimated Potential Reduction in Lead Uptake Associated with Different Intervention Measures
  - Education Intervention Measures (0-50%)
  - Interim Measures (20 – 70%)
  - Cleanup Measures (50 – 100%)
- Qualifiers

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## Lead-Contaminated Soils Incremental Impacts on Child PbB



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## Stern Lead Model

$$\text{PbS} = \frac{(\Delta \text{PbB}_{\text{brc}})}{(\text{BKSF})(\text{UF})}$$

Where:

- PbS = Concentration of Lead in Soils
- $\Delta \text{PbB}$  = Incremental PbB defined as de minimis, acceptable or below regulatory concern
- BKSF = Biokinetic slope factor relating lead uptake with increases in child PbB
- UF = Uptake factor relating soil concentrations with lead uptake by children

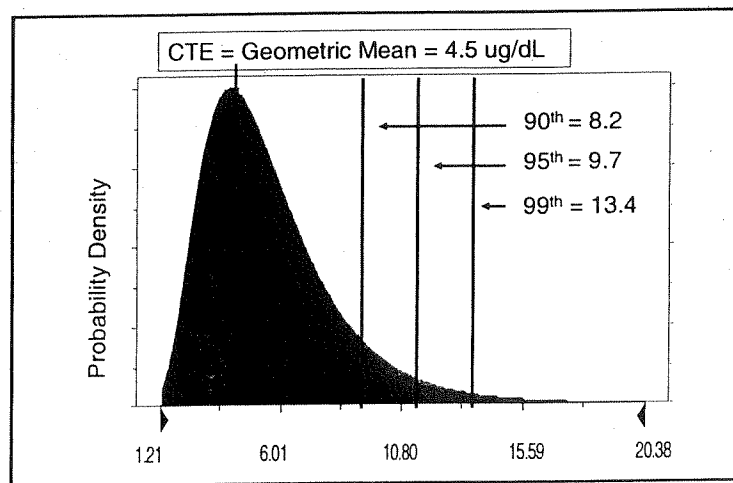
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## Assumptions and Approach

- IEUBK Model used to estimate  $PbB_{child}$  which represents a central tendency estimate (CTE).
- Soil-related changes in  $PbB_{child}$  are estimated by subtracting background  $PbB$  levels (soil concentration = 20 mg/kg) from CTE values.
- $PbB_{child}$  corresponding to “reasonable maximum exposure”
  - Assume  $PbB$  levels are lognormally distributed
  - Assume CTE value = geometric mean
  - Assume GSD = 1.6
  - Estimate 90<sup>th</sup>, 95<sup>th</sup> and 99<sup>th</sup> percentile values

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## Estimated $PbB$ Concentrations (Soil Concentration = 400 mg/kg)



Predicted Blood Lead Concentrations (Age Interval 12- 36 months)

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**Preliminary Draft (Discussion Only)**  
**Estimates of Soil-Related Impacts on Child Blood Lead**  
**Concentrations**

Soil Lead Concentration	PbB (CTE)	Soil-Related Change in PbB (CTE)	Est. Soil-Related Change in PbB (90th percentile)	Est. Soil-Related Change in PbB (95th percentile)	Est. Soil-Related Change in PbB (99th percentile)
<b>0-84 Month Age Interval</b>					
20	1.2	0	0.0	0.0	0.0
100	2.0	0.8	1.5	1.7	2.4
200	2.8	1.6	2.9	3.5	4.8
250	3.3	2.1	3.8	4.5	6.3
300	3.8	2.6	4.7	5.6	7.8
400	4.6	3.4	6.2	7.4	10.1
500	5.4	4.2	7.7	9.1	12.5
600	6.2	5	9.1	10.8	14.9
700	7.0	5.8	10.6	12.6	17.3
800	7.7	6.5	11.9	14.1	19.4
<b>12-36 Month Age Interval</b>					
20	1.3	0	0.0	0.0	0.0
100	2.4	1.1	2.0	2.4	3.3
200	3.6	2.3	4.2	5.0	6.9
250	4.0	2.7	4.9	5.8	8.1
300	4.7	3.4	6.2	7.4	10.1
400	5.8	4.5	8.2	9.7	13.4
500	6.9	5.6	10.2	12.1	16.7
600	7.9	6.6	12.1	14.3	19.7
700	8.8	7.5	13.7	16.2	22.4
800	9.7	8.4	15.3	18.2	25.1



## **Results**

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- Predicted PbB levels associated with soil exposure (column #3) are lower than predicted PbB levels based on total lead exposure (column #2).
- Predicted RME PbB levels associated with soil exposure (column #5) are @2-2-5 times higher than predicted CTE PbB (column #3).
- The preliminary results are consistent with Stern (1994) who recommended a PRG of 200 mg/kg (based on  $\Delta\text{PbB} = 2 \text{ ug/dL}$ ).
- Predicted RME PbB (soil only) at a soil concentration of 200 mg/kg is 5 ug/dL (column #5 for 12-36 month age interval).

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## **Summary**

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- **Qualifiers – Preliminary Analyses**
- **Other Possible Analyses**
  - **Other Exposure Scenarios**
  - **Use  $\Delta$  IQ as Health Effect Measure**
  - **Probabilistic Estimates**

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## **Discussion Questions**

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- **Upper End of "Moderate" Range**
- **Lower End of "Moderate" Range**
- **Soil Concentrations Below 250 mg/kg**
- **Protection of Adults and Older Children**
- **Protection of Ground Water**
- **Future Information Collection and Evaluation**

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## **Upper End of "Moderate" Range**

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- **Question:** Does the Science Advisory Board agree that the methods and assumptions used by Ecology to define the upper end of the moderate range are scientifically defensible?
- **Rationale:**
  - CDC Guidelines
  - Use of IEUBK Model
  - Reasonable exposure parameters and assumptions
  - Reasonable steps to reduce exposure

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## **Lower End of "Moderate" Range**

- Question: Does the Science Advisory Board agree that the methods and assumptions used by Ecology to define the lower end of the moderate range are scientifically defensible?
- Rationale:
  - CDC Guidelines/MTCA Method A Soil Cleanup Level
  - Use of IEUBK Model
  - Reasonable exposure parameters and assumptions

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## **Soil Concentrations Below 250 mg/kg**

- Question: Does the Science Advisory Board believe there is a sound scientific justification for providing information on ways to reduce lead exposure in situations where soil concentrations are below the MTCA cleanup level (i.e. < 250 mg/kg)?
- Arguments For:
  - Scientific evidence of adverse health effects at PbB < 10 ug/dL
  - Importance of primary prevention
  - Information as a prerequisite to primary prevention
- Arguments Against:
  - Uncertainty on cause-effect relationships
  - CDC decision to maintain current guidelines
  - Costs and loss of focus

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## **Protection of Adults and Older Children**

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- Question: Does the Science Advisory Board agree that it is scientifically defensible to conclude that levels protective of young children also protect older children and adults?
- Rationale:
  - Relative Sensitivities of Young Children and Adults/Older Children
  - Health Endpoints in Adults
  - Modeling Results

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## **Protection of Ground Water**

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- Question: Does the Science Advisory Board agree that it is scientifically defensible to conclude that surface soil lead concentrations below 1000 mg/kg are unlikely to significantly impact ground water?
- Rationale:
  - Soil profiles of lead concentrations at different depths in former orchards
  - Soil profiles of lead concentrations at different depths in areas surrounding former smelters
  - Results of fate and transport modeling and assumptions underlying MTCA Method A Soil Cleanup Levels

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## **Future Information Collection and Evaluation**

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- Question: Given available information, where does the SAB recommend that Ecology focus future information collection and review?
- Board Suggestions Provided at Previous Meetings:
  - Roadside Lead Concentrations
  - Variations in Blood Lead Concentrations
  - Variations in Soil Lead Concentrations
  - Lead Concentrations in Vegetables
  - Potential pH effects on migration of lead in soils
  - Review of Method A Soil Cleanup Level

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## **Next Steps**

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- Board Conclusions on Lead-Contaminated Soils/Additional Analyses
- Soil-to-Ground Water Issues (Fall 2004)
- Arsenic-Contaminated Soils (Fall 2004)
- Application of MTCA Ecological Evaluation Procedures to Example Sites (Fall 2004)

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